



## Obstacle Detection During HDD Operations

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## Obstacle Detection for Horizontal Directional Drilling (HDD)



- > Significant increase in the use of HDD for laying pipes
- > Knowledge of various objects in front of drill head is critical to avoid hits
- > Horizontal drilling heads can penetrate other obstacles such as sewers, plastic gas pipes, electric lines, or fiber optic cables
- > Presentation will discuss progress on detecting obstacles during HDD operations



## Obstacle Detection Technologies



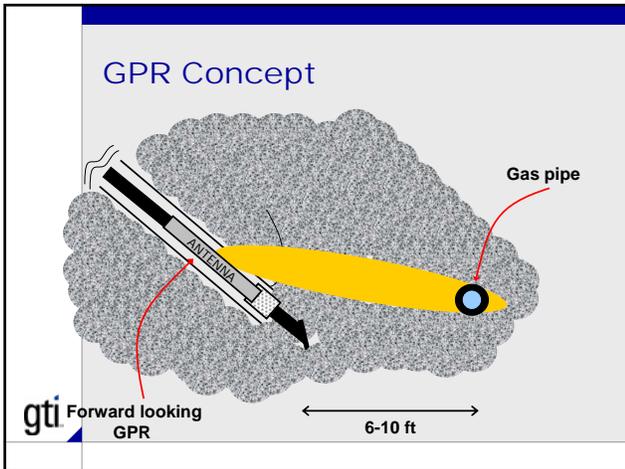
- > Ground Penetrating Radar (GPR)
- > Integrated Acoustic - Electromagnetic
- > Differential Impedance



## Objectives

- > Sensitivity to obstacles 6 to 10 feet ahead
- > Package sensor for testing on or with drilling rig
- > System cost (\$5K-\$8K), i.e., cost no more than 10% of the entire drilling machine





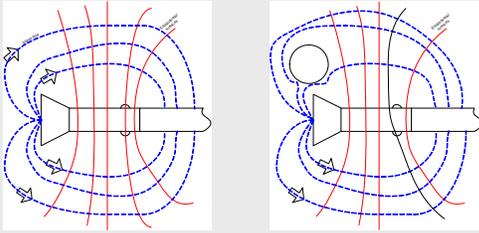
- ### GPR for HDD
- Radar
    - > Small and robust electronics packaging
      - Size started at 26", then to 19" currently at 17"
    - > Easily used operating software
    - > Improved display
  - Antenna
    - > Increased power transmission into ground
    - > Improved clutter suppression for clearer images
    - > Better coupling reduction for improved target detection
  - Mechanical
    - > Improved downhole communication system

- ### Acoustic/EM System
- > Detect and locate underground utilities using sonics and electromagnetic sensors
    - PE, sewer and water pipes
    - Metallic pipes
    - Telephone, cable, fiber optics and electrical conduits
  - > Integrate sensor technologies with horizontal directional drilling (HDD) operation
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- ### Acoustic/EM status
- Design, fabrication, and testing of acoustic system complete
  - Wireless interface for active detectors installed
  - Acoustic system with data fusion delivered for testing
  - Design, fabrication, and testing of noise maker complete
  - Test fields of pipes installed
  - All electronics and non-magnetic jet head designed and assembled
  - Factory testing of FFT detections complete
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## Differential Impedance Sensing

- > Obstacles in the soil cause changes in the soil impedance



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## Differential Impedance

### > Advantages

- High sensitivity to plastic pipe
- Use of drill head to inject signal current minimizes modifications to drill
- Eliminates any blind spot dead ahead
- Low frequency of operation allows lower cost electronics
- System self-contained, requiring no sensors on the surface and no "walker"



### > Disadvantages

- Poor imaging compared to GPR
- Has to improve for false positives, e.g., dry voids in soil

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## DI Results

- > Sensitive to sense 4" plastic pipe through 3 feet of intervening soil
- > Orientation of the pipe to the sensor resolved
- > Sensitivity to objects greater on the sides of sensor than dead ahead
- > Effects of soil characteristics on field lines greater than originally anticipated
- > Additional improvements with the use of finite element simulation technique

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## Conclusion

**Parallel path approach for the challenging development on obstacle detection technology for HDD operations**

Questions?

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